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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD LOS ANGELES REGION

272

MEMORANDUM

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VIA: Jim Carlisle, D.V.M., Chief,
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FROM: Julio A. Salinas, Ph.D., Biochem.D.
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DATE: October 23, 2002

SUBJECT: REVIEW OF THE SOIL INVESTIGATION, SHALLOW SOIL REMEDIATION AND SCREENING LEVEL RISK ASSESSMENT FOR FORMER BOEING C-6 FACILITY - PARCEL C, TORRANCE, LOS ANGELES COUNTY, CALIFORNIA. TASK ORDER NO. R4-02-21

Upon request from the Regional Water Quality Control Board, Los Angeles (RWQCB-LA), I reviewed the report entitled "Soil Investigation, Shallow Soil Remediation and Screening Level Risk Assessment, Volumes 1 and 2, Boeing Realty Corporation, Former C-6 Facility, Parcel C, Los Angeles, California" (hereinafter the "Report"). The Report was prepared by Haley & Aldrich, Inc., San Diego, California, and is dated March 13, 2002. I also had the opportunity to review the Workplan and a Technical Addendum to the Workplan for this site and the comments below reflect the consistency between the Report and the Workplan.

Background

Parcel C is a 50.5-acre portion of the 170-acre Former Boeing C-6 Facility in Torrance, under redevelopment by Boeing Realty Corporation. The aircraft manufacturing and assembly facility that existed on this property has been demolished, the area has been re-graded, and surface and subsurface infrastructure have been removed (all surface infrastructure from the original operations were razed, subsurface features dug up and removed from the site). The property is to be subdivided into lots for sale, lease, and/or redevelopment for commercial/industrial uses.

Objectives of the Proposed Screening Risk Assessment

The objective of the screening risk assessment (SRA) is to provide health risk estimates associated with potential exposure to residual site-related chemicals of potential concern (COPCs) in soil and groundwater within Parcel C property boundary, and based on existing conditions after completion of site investigation, demolition, remedial excavation, remediation confirmation sampling, and grading activities.

The SRA follows the approach proposed in the Workplan, previously reviewed by the Office of Environmental Health Hazard Assessment (OEHHA). Boeing and Haley & Aldrich further explained some issues described in the Workplan in recent telephone conferences.

Soil contamination

Soil was sampled and analyzed for metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and soil gas VOCs contaminants. According to the Report, 233 known and suspected potential source areas were investigated. Soil borings were drilled from the surface to 65 feet (ft) below ground surface (bgs) and approximately 5,900 soil samples and post demolition confirmation samples were collected from over 1,200 distinct locations. A total of 169 soil gas samples were also collected at the site. A step-out/step-down method was used to delineate the contamination, by comparing the latest analytical result to previously developed soil gas screening concentrations (SGSCs) or soil field action levels (SFALs). This procedure was described in the Workplan and is appropriate.

For metals, the concentration of each metal identified on site was compared to the facility specific background concentration. Metal COPCs considered in the SRA are all those exceeding background, plus Cr (+6) and cyanide. In shallow soil (0-12 ft bgs) 37 VOCs and 34 SVOCs were identified. In deep soil (>12 ft bgs), there were 37 VOCs identified (5 different from those in shallow soil), 25 of the SVOCs detected in shallow soil, and 10 soil gases.

Two areas of <u>TCE</u> contamination in soil were defined (shown in Figures 8 to 32). One, under Buildings 1 and 36 ("Building 1+36"), extends to the north of Parcel C extending to at least 50 ft bgs with a reported maximum TCE of 97,000 µg/kg at 20-25 ft bgs. Another plume extends under Building 2 with a reported maximum TCE of 82,000 µg/kg at 50 ft bgs. The TCE plume under Buildings 1+36 is co-contaminated with 1,1,1-TCA and toluene. Soil shows contamination with <u>toluene</u> extending to at least 60 ft bgs with a reported maximum of 1,400,000 µg/kg, and <u>1,1,1-TCA</u> extending to at least 60 ft bgs with a reported maximum of 5,200,000 µg/kg. The organic contaminants detected in soil, groundwater, and soil gas are presented in Table A-2, with the following maximum concentrations: 20,000,000 µg/kg of methylene chloride, 8,700,000 µg/kg of Methyl-Ethyl-Ketone, 1,300,000 µg/kg of 4M2P, 3,700,000 µg/kg of toluene, 59,000,000 µg/kg of 1,1,1-TCA, and 29,000,000 µg/kg of xylenes. It would have been appropriate to define the criterion used to predict volatility of the contaminants, i.e., not volatile if Henry's constant (K_H) is <1E-05 atm·m^3/mol and rapidly volatile if K_H >1E-03 atm·m^3/mol.

According to RWQCB-LA (John Geroch, personal communication), Boeing produced all hazardous waste and non-hazardous waste manifests for the offsite disposal of the contaminated soil. Clean imported soil was used for the final grading, but a typical soil analysis is not presented in the Report. Information referred to, as the "remedial excavation activities in Section 2.3.1" and "criteria for acceptance of import soil in Section 2.3.3" were not found in the Report.

In the screening risk assessment for residual contamination, all metals exceeding the site-specific background, all detected organic contaminants in shallow soil, and all VOCs in soil gas or in soil or groundwater but not analyzed in soil gas, were considered COPCs and are shown in the Report in Table A-3.

Soil Investigation Confirmation Sample Results and Remedial Excavations

Remedial activities included excavation of shallow soil. Table 16, Summary of Shallow Soil Excavations, is shown as part of Figure 16 - Soil Investigation Confirmation Sample Results and Remedial Excavations. Some of the remediated locations show presence of contaminants, and the authors explain that the remaining contamination is greater than 12 ft bgs and will be addressed as part of the deep soil remedial program.

Soil Remediation

Following demolition and debris removal, and based on results of soil and soil gas analysis, 34 locations of contaminated shallow soil (0 to 12 ft bgs) were identified in Parcel C and were remediated by excavation of a minimum of 5 ft to a maximum of 22 ft bgs. According to the Report, an area with TPH (total petroleum hydrocarbons) extending down to 26 ft bgs was remediated by excavation. The deep soil contamination under Building 1+36 and Building 2 include VOCs to a depth of about 65 ft bgs which will be remediated by soil vapor extraction (SVE).

Groundwater Contamination

Groundwater at the site is at approximately 65 ft bgs and is contaminated with: <u>TCE</u> (reported maximum 21,000 µg/L) under Buildings 1, 36, 41, and most of Building 2; <u>1,1-DCE</u> (reported maximum 24,000 µg/L) under Building 1, 36, 41, and about half of Building 2; and <u>1,1,1-TCA</u> (reported maximum 1,100 µg/L) under Buildings 1, 36, and 41. Groundwater is considered not suitable for water supply purposes, and therefore exposure assessment does not include the drinking water pathway, however it is assessed as a contaminated water body acting as a source of hazardous contaminants.

Groundwater contamination is shown graphically in Figure 30 for TCE, and in Figure 31 for 1,1-DCE. A Summary of Organic Chemicals Concentrations in soil, groundwater and soil gas showing six organic contaminants (acetone, MEK, 4M2P, styrene, 1,2,4-TMB, and 1,3,5-TMB) in groundwater is shown in Table A-2. Vinyl chloride, a common degradation product of 1,1,1-TCA, PCE, and TCE, and recognized human carcinogen, was not detected in soil gas or in ground water at Parcel C. The authors explained that the soil vapor extraction system was not running at the time of the soil matrix or soil gas sampling and therefore soil gas concentrations could not have been affected by the system.

In the risk assessment, all metals exceeding the site-specific background, and all detected VOCs and SVOCs in groundwater were considered COPCs.

Migration and Exposure Pathways and Conceptual Site Model

The Conceptual Site Model (CSM) shown in Table A-4 is appropriate and relies on current sampling and analysis for contamination, instead of modeling migration and fate. The CSM however does not discuss the *temporal* component of the migration and exposure pathways. A currently incomplete or insignificant exposure pathway may become complete or significant in the future because of migration of contaminants. Therefore the definition used in the Report for incomplete or insignificant pathways are applicable only if the fate and migration pathways are mitigated, that is, assuming contaminant remediation.

Exposure Point Concentration

All samples representing current soil conditions and taken from shallow soil (0 to 12 feet bgs), plus any soil from deeper zones that had been brought to the surface during excavation, were included in the risk assessment. Examples of spreadsheets with raw data showing calculation of exposure point concentration (EPC) for arsenic and benzo[a]pyrene were provided by Boeing and Haley & Aldrich. The calculations were verified and the results are correct.

The statistical method for estimating the 95 percent upper confidence of the arithmetic mean (95 percent upper confidence limit (UCL)) for normally- or lognormally-distributed data was discussed and are appropriate. The authors used the H-statistics method, a method that is sensitive to variance and group size, and hence its robustness has been questioned in the scientific literature. In my opinion this topic is not an issue external to the present project. Results of benzo[a]pyrene analysis span four orders of magnitude (min=0.42; max=6100) and therefore the distribution is expected to be lognormal, but the arsenic results are within one order of magnitude (min=0.5; max=23.5) and hence the distribution is normal. The analysis conducted by the authors is therefore appropriate.

Because Parcel C is planned as a *commercial property* and the *highest* soil vapor concentrations were assumed for exposure throughout the property, use of central tendency values (95 percent UCL of the mean) on large parcels would not underestimate exposure and risk if the site were to be divided into smaller parcels. I conclude that the procedure used is correct, and the results are sufficiently conservative for use in exposure assessment, and therefore the use of the H-test was appropriate for the purpose of the present risk assessment.

There were some high analytical detection limits for VOCs in some of the soil matrix samples, but the authors explained that when high detection limits were encountered, adjacent soil matrix or soil vapor samples were evaluated to determine if VOCs were or were not present. In the specific case of vinyl chloride, adjacent data showed that it was not present at the site and therefore it was excluded from the risk assessment. The vapor extraction system (VES) was not operating during the soil matrix or soil vapor sampling; therefore soil vapor concentrations could not have been affected by the system. During and following operation of the VES remediation system, VOC concentrations, and therefore exposures and risks would be lower than those estimated. It was also noted that the VES is reducing concentrations in one area with co-located contaminants and therefore use of a central tendency value (95 percentUCL) is an appropriate representative value for this site.

Exposure assessment

Parcel C will be developed for mixed-use commercial and industrial purposes, and therefore a residential scenario was not considered. A residential exposure scenario would require a different set of more stringent assumptions and would produce more conservative exposure and risk estimates.

For shallow soil (0-12 ft bgs), the proposed exposure point concentrations are the lower of the 95 percent UCL of the mean <u>or</u> the maximum concentration, which are reasonable representative estimates.

For deep soil (>12 ft bgs), soil gas, and groundwater, the selection of the maximum concentration of each detected contaminant as representative for the risk assessment, is a very conservative assumption. The overall approach is conservative since in addition it assumes that the inventory of COPCs is constant over time, that is, the nature, extent and severity of the contamination will remain at the existing site conditions, and that all COPCs are co-located during exposure, that is, the receptor is exposed to all COPCs detected at this site.

The selection of receptors of interest for future exposure scenarios is appropriate, including exposure pathways of potential concern. However the Report does not discuss exposure among on-site demolition and remediation workers. It is unclear whether exposure was deemed insignificant, although direct skin contact with soil, and inhalation of VOCs and resuspended soil may be significant during this stage.

The San Diego County Site Assessment and Mitigation (SAM) Manual vapor transport and risk calculation model was used to estimate the vapor intrusion of subsurface VOCs into indoor air. This model is simpler than the Johnson and Ettinger model, and is useful for screening purposes.

In this SRA, the future on-site industrial worker would be subject to the highest levels of exposure for the longest time, and therefore can be used as a surrogate receptor for all other receptors. The proposed exposure pathways and exposure factors for this receptor are reasonable and supported.

According to Section A.5.2, Intake Assumptions, exposure among future on-site industrial worker was estimated as follows:

- Ingestion of soil, inhalation of particles and vapors in outdoor air, and dermal contact with soil, were estimated using the industrial U.S. Environmental Protection Agency (EPA) Region 9 preliminary remediation goals (PRGs) adjusted for California toxicity criteria.
- Inhalation of VOCs in indoor air was estimated using the SAM approach.

The health risk calculations were conducted using results of analysis of confirmation samples taken after excavation to verify that no further remediation is necessary.

Target risk levels

The Office of Environmental Health Hazard Assessment (OEHHA) does not propose or approve target risk levels. This risk management decision belongs to the RWQCB-LA. OEHHA only verifies that the proposed approach is reasonably protective of human health and that the methods and procedures used in the risk assessment are scientifically justified and acceptable to the State. For example, Integrated Risk Assessment Section (IRAS)/OEHHA verifies that the reported estimated risk values reflect the cumulative health risks resulting from all residual contaminants and exposure pathways in the exposure scenario under the current site conditions.

Risk Characterization

Estimation of lifetime excess cancer risk (LECR) and total hazard index (THI) was conducted using standard methods in risk assessment. Carcinogens classified as U.S. EPA Weight of Evidence Group C should not have been considered, and therefore for 1,2,3,4-tetrachlorobutane – a group C carcinogen - Table A-5 should not show a contribution to LECR. IRAS/OEHHA does not recommend inclusion of carcinogens Group C, since there is no evidence of their carcinogenicity in animals or humans. Excluding 1,2,3,4-TCB would lower the total risk fractionally.

The on-site worker in a hypothetical future commercial/industrial redevelopment scenario receptor served as conservative surrogate for all five receptors identified for this redevelopment scenario. The estimated LECR for this worker is 4.6E-06. This means that a worker exposed over a 25-year period to the identified residual contaminants at Parcel C by the oral (incidental soil ingestion), dermal (direct contact with soil), and inhalation (to VOCs from subsurface intrusion into buildings, VOC emissions into ambient air, and inhalation of fugitive dust), would have an extra probability of 4.6 in 1 million of developing cancer. Benzo[a]pyrene is the largest contributor to cancer risk, accounting for 35 percent of the total, but contribution on a pathway basis were not provided. The LECR is within the 1E-06 to 1E-04 risk range recognized by the National Contingency Plan for risk decision-making, and therefore the RWQCB-LA needs to make a decision about acceptability of the risk estimate.

The estimated THI for this worker is 0.90, irrespective of toxic endpoint. A THI of one (1) or less indicates that a worker annually exposed to the residual contaminants by the specified routes as before, would not be at risk, even if the receptor is hypersusceptible. Main contributor to hazard index is 1,3,5-trimethylbenzene with 43 percent of the total. This THI is below the target hazard index of 1 (one) and therefore, because of the embedded conservatism of multiple assumptions, it should not be a source of concern.

Other comments

The tabular presentation of data and results, and the graphics in the Report are excellent. They are clear and readable, in particular considering the high level of complexity and the large amount of information contained in each.

SUMMARY OF OEHHA REVIEW

The soil investigation, shallow soil remediation, and screening level risk assessment conducted by Haley and Aldrich for the Former Boeing C-6 Site, Parcel C, in Torrance, California is comprehensive, sound, and appropriate for the protection of human health and for the intended commercial/industrial uses of the property. The estimated shallow soil residual lifetime cancer health risk of 4.6×10^{-6} is within National Contingency Plan range for risk decision-making and the combined hazard index of 0.9 suggests that adverse non-cancer health effects are unlikely. As long as the nature and severity of the contamination is as characterized, it can be expected that even small variances from the determined variables should not be cause for concern among people working in this area.

The communication and assistance provided by Boeing and Haley & Aldrich work team as well as from the RWQCB-LA throughout the conduct of this health risk assessment is acknowledged.

I appreciate the opportunity to work on this project.